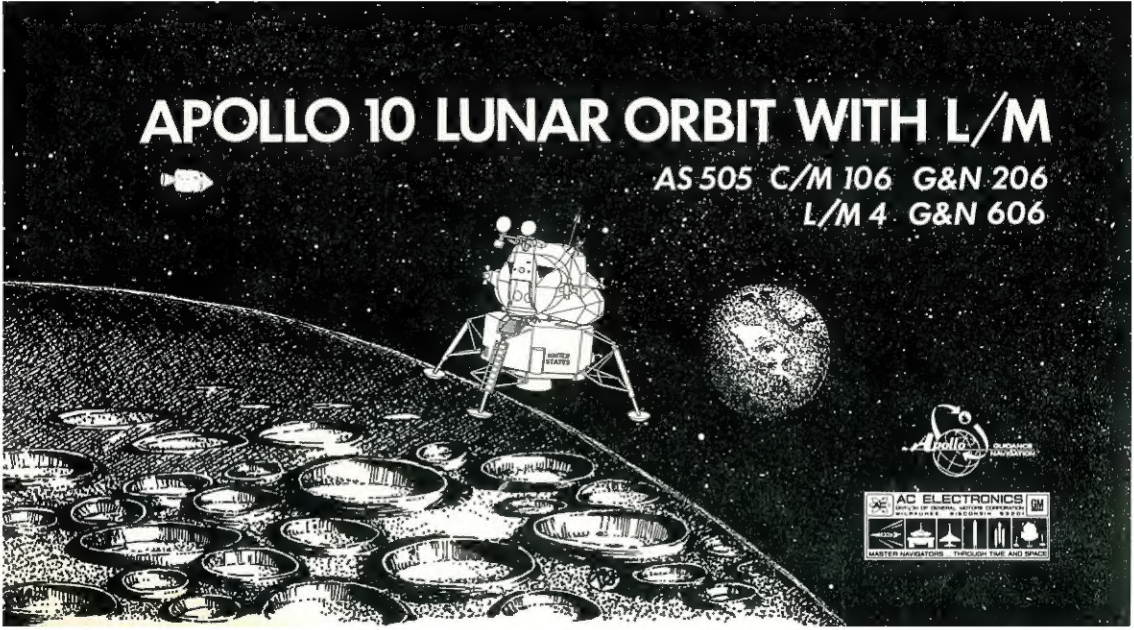
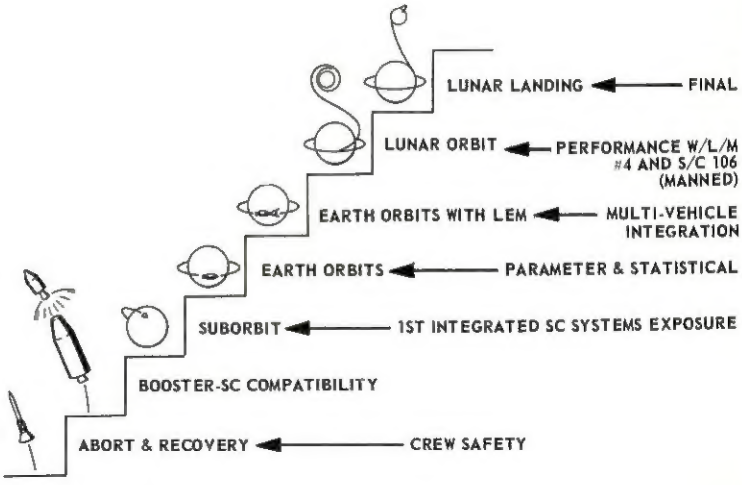

APOLLO 10 LUNAR ORBIT WITH L/M
AS 505 C/M 106 G&N 206
L/M 4 G&N 606
Apollo
GUIDANCE NAVIGATION
AC ELECTRONICS
DIVISION OF GENERAL MOTORS CORPORATION
MILWAUKEE, WISCONSIN 53201
GM
MASTER NAVIGATORS... THROUGH TIME AND SPACE

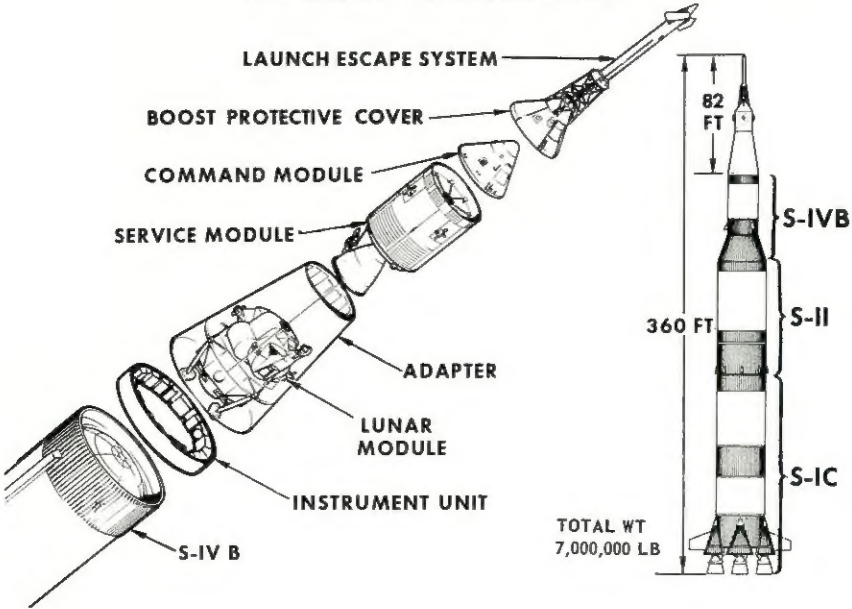
SPACECRAFT DEVELOPMENT FLIGHT CATEGORIES

MAJOR STEPS TO ULTIMATE MISSION

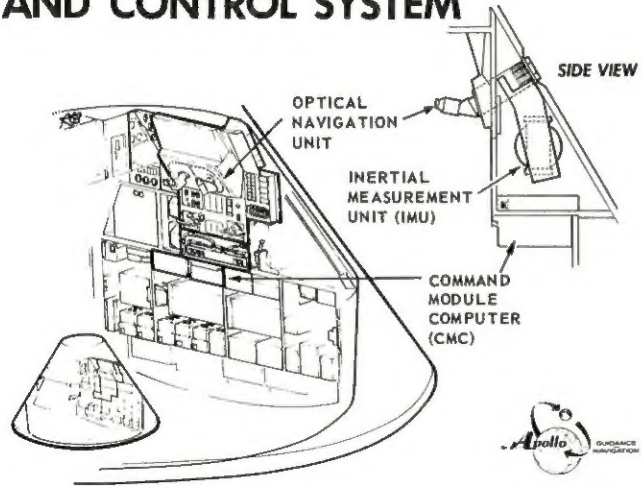
BP 6 PAD OBORT
BP 12 TRANSONIC ABORT
BP 13 BOOSTER
BP 15 BOOSTER
BP 22 HI ALTITUDE ABORT
BP 23 HI Q ABORT
BP 23A PAD ABORT
SC 002 TUMBLING ABORT
SC 009 SUB-ORBITAL
AS 202 S/C11 SUBORBITAL
APOLLO-4 AS501 S/C17
EARTH ORBIT (3 REV)
APOLLO-5 AS204 LM 1
EARTH ORBIT (4 REV)
APOLLO-6 AS502 S/C020
EARTH ORBIT (3 REV)
APOLLO-7 AS205 S/C101
EARTH ORBIT (10 DAYS)
APOLLO-8 AS503 S/C103
LUNAR ORBIT (6 DAYS)
APOLLO-9 AS504 S/C104
LM3 EARTH ORBIT W/LM (10 DAYS)
APOLLO-10 AS505 S/C106
LM4 LUNAR ORBIT W/LM (8 DAYS)



APOLLO SPACECRAFT



C/M GUIDANCE, NAVIGATION, AND CONTROL SYSTEM



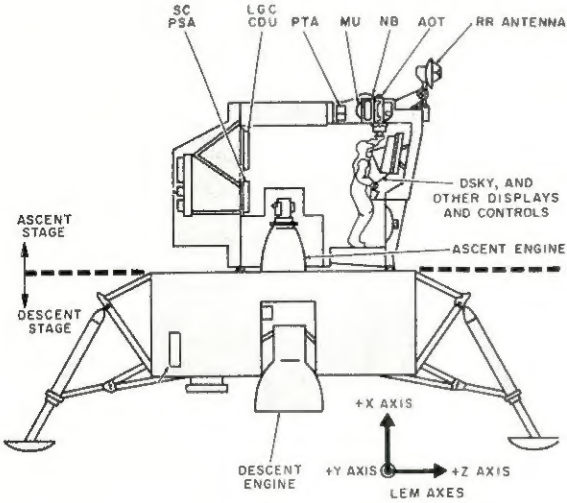
THE APOLLO GUIDANCE AND NAVIGATION SYSTEM IS COMPOSED OF THREE BASIC SUBSYSTEMS: INERTIAL, OPTICAL AND COMPUTER.

1. The inertial guidance subsystem is composed of inertial measurement unit (IMU) and associated equipment. This subsystem performs three major functions: (A) Measures changes in spacecraft attitude; (B) Measures spacecraft velocity due to thrust; and (C) Assists in generating steering signals.

2. The optical navigation subsystem is composed of a space sextant and a scanning telescope. Sightings on celestial bodies and landmarks on the moon and earth are used by the computer subsystem to determine the spacecraft's position and velocity and to align the inertial reference within the IMU.

3. The command module computer (CMC) provides five major functions: (A) Calculates steering signals and engine discretes necessary to keep the spacecraft on the required trajectory; (B) Positions the stable member in the IMU to a coordinate system defined by precise optical measurements; (C) Positions the optical unit to celestial objects; (D) Conducts limited malfunction isolation of the G&N system by monitoring the level and rate of system signals; and (E) Supplies pertinent spacecraft condition information to the display and control panel.

L/M GUIDANCE AND NAVIGATION EQUIPMENT LOCATION AND DESCRIPTION



INERTIAL MEASUREMENT UNIT (IMU) and associated equipment performs three major functions: (A) Measures changes in LM attitude, (B) Assists in generating steering commands, and (C) Measures LM velocity changes due to thrust. This unit manufactured by AC Electronics.

ALIGNMENT OPTICAL TELESCOPE (AOT) Provides star sighting data which is manually inserted into the LM Guidance Computer for establishing the inertial reference. This unit manufactured by Kollsman Instrument Company.

NAVIGATION BASE (NAV BASE) Provides an accurate mounting base for the Alignment Optical Telescope (AOT) and the Inertial Measurement Unit. This unit manufactured by AC Electronics.

LM GUIDANCE COMPUTER. (LGC) Performs four major functions: (A) Calculates steering signals and engine discretes necessary to keep the LM on the required trajectory. (B) Positions the stable member in the IMU to a coordinate system defined by precise optical measurements, (C) Conducts limited malfunction isolation of the PGNCS by monitoring the level and rate of system signals, and (D) Supplies pertinent LM condition information to the display and control panels. This unit manufactured by Raytheon.

DISPLAY AND KEYBOARD (DSKY) Provides a two-way communication link between the operator and the LGC and the following functions may be performed: (A) Loading of data into the LGC, (B) Display of data and system configuration to the operator. This unit manufactured by Raytheon.

COUPLING DATA UNIT (CDU) The CDU, an all-electronic device, is used as an interface element between the following: (A) The inertial subsystem and computer subsystem, (B) and the computer subsystem and the controls. This unit functions primarily as an analog to digital or digital to analog converter. This unit manufactured by AC.

APOLLO 10 MISSION DESCRIPTION

1. MANNED

PRIME CREW		BACK-UP CREW
Thomas P. Stafford	Commander (CDR)	LeRoy G. Cooper Jr.
John W. Young	Command Module Pilot (CMP)	Donn F. Eisele
Eugene A. Cernan	Lunar Module Pilot (LMP)	Edgar D. Mitchell

2. Third Manned Saturn V Mission
3. First CSM/LM Lunar Orbit W/Pacific Ocean Recovery
4. Planned Duration 8 Days
5. Booster Saturn V Booster No. 505
6. Spacecraft CSM #106 and Lunar Module #4
7. Block II G & N System #206 L/M G & N System #606

APOLLO 10 MISSION OBJECTIVES

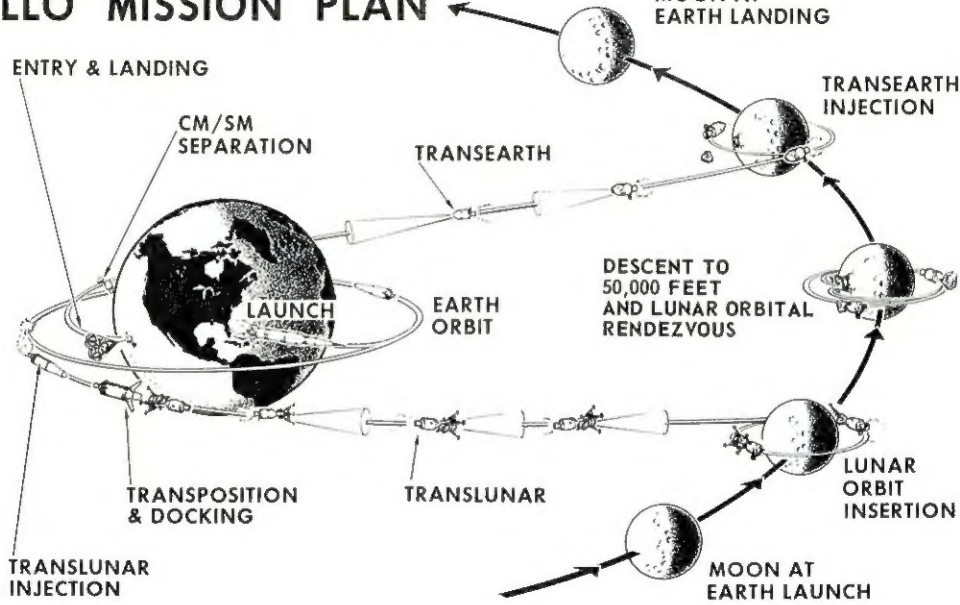
The purpose of the Apollo 10 Mission is to demonstrate the adequacy of spacecraft systems and all S/C and ground support operations to satisfactorily perform their assigned functions in deep space and in a lunar environment.

CISLUNAR AND LUNAR OPERATIONS:

- LM active rendezvous
- PGNCS undocked DPS performance
- Crew activities in lunar orbit
- LM communications, voice and TM
- LM/CSM visibility, landmark tracking and orbit determination
- Spacecraft thermal control docked
- LM OMNI antennas lunar distance
- AGS/APS long duration burn
- Rendezvous radar performance
- Landing radar test
- LM SHE evaluations
- AGS evaluations
- VHF ranging evaluation
- Ground support lunar distance

SEQUENCE OF MAJOR EVENTS	GET HR.	MIN.	SEC.	BT
EVENT				
LAUNCH AND EPO				
1. EOI	00	11	43	
2. TLI (SECOND REV)	2	33		5 MIN 22 SEC
TRANSLUNAR COAST				
SIVB SEPARATION	3	00		
TRANSPOSITION DOCKING	3	10		
CISLUNAR NAVIGATION	5	30		
MIDCOURSE CORRECTION #1	11	33		8.1 SEC
MIDCOURSE CORRECTION #2	20	33		
MIDCOURSE CORRECTION #3	53	45		
MIDCOURSE CORRECTION #4	70	45		
LOI_1 WILL BE PERFORMED AT	75	45		6 MIN 2 SEC
LUNAR ORBIT				
LOI_2 WILL BE PERFORMED AT	80	10		14.4 SEC
LM UNDOCK	98	35		
DOI	99	34		27.7 SEC
DPS (PHASING)	100	46		42.0 SEC
RCS (STAGING)	102	33		
APS (INSERTION	102	43		15.5 SEC
RCS (CSI)	103	33		32.1 SEC
RCS (CDH)	104	31		2.4 SEC
RCS (TPI)	105	09		15.6 SEC
MIDCOURSE CORRECTION #1 (LM)	105	24		
MIDCOURSE CORRECTION #2 (LM)	105	39		
RENDEZVOUS	105	54		
DOCKING	106	20		
L/M JETTISON	108	09		
APS BURN TO DEPLETION	108	39		
TEI	137	20		2 MIN 50 SEC
TRANSEARTH COAST (TEC) & ENTRY				
STAR/LUNAR NAVIGATION SIGHTINGS (3 SETS)				
MIDCOURSE CORRECTION #5	152	20		
MIDCOURSE CORRECTION #6	176	50		
MIDCOURSE CORRECTION #7	188	50		
CM/SM SEPARATION	191	35		
ENTRY INTERFACE	191	50		
SPLASH DOWN PACIFIC OCEAN	192	04		

APOLLO MISSION PLAN



CSM BURN SCHEDULE

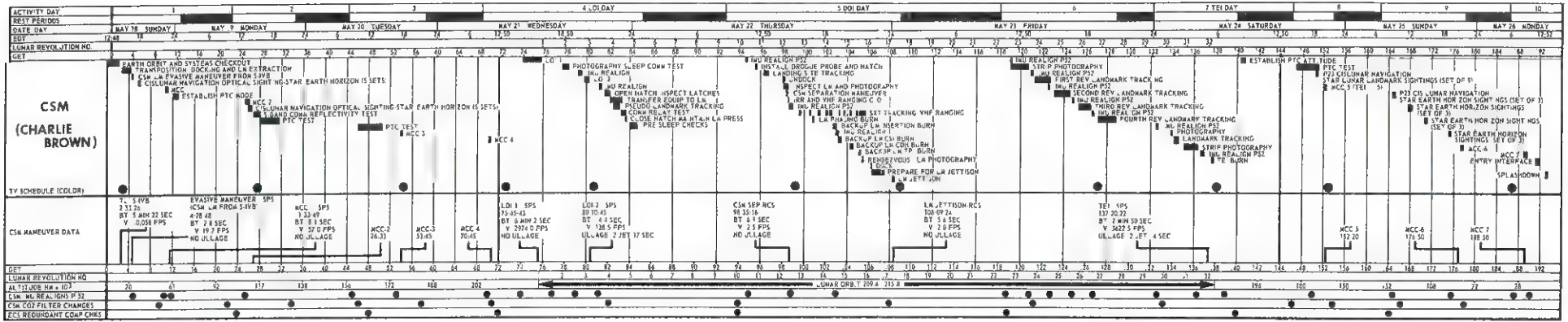
Burn/Mnvr.	GETI Burn Time ΔV_C	Attitude (deg) LH/LV	Attitude (deg) Inertial	Lighting at GETI	ΔV (fps)	Ullage ΔV (fps)	TVC Mode	REFS MMAT	ΔV Result (SC wt., H_P, H_A)	Remarks
S-IVB TLI	2:33:26 5 min 22 sec 10,058 fps	R: P: Y:	R: P: Y:		X: Y: Z:		S-IVB I. U.	PAD		
CSM/LM Evasive Mnvr. from S-IVB	4:28:48 2.8 sec 19.7 fps	R: 180.1 P: 282.6 Y: 1.8	R: 180.7 P: 163.3 Y: 0.0	Light	X: 5.1 Y: 0.0 Z: 19.0	None		PAD	WT: 94,575	Use Bank A engine ball valves
MCC-1	11:33:49 8.1 sec 57.0 fps	R: 8.3 P: 142.6 Y: 9.2	R: 7.1 P: 3.2 Y: 10.5	Light	X: -42.9 Y: 10.5 Z: -36.0	None		PTC	WT: 94,392	Use Bank B engine ball valves
MCC-2 thru MCC-4	26:33) 53:45) GETI 70:45)			Light	Nom. Zero	Nom. Not Req.	G&N Auto	PTC PTC LLS-2		TLI 24 hours LOI-22 hours LOI+5 hours
LOI-1	75:45:43 6 min 2 sec 2974 fps	R: 356.5 P: 162.8 Y: 345.6	R: 356.3 P: 232.0 Y: 340.5	Light (SS - 8:17)	X: -2912.9 Y: -587.5 Z: -201.0	None	G&N Auto	LLS-2	WT: 92,427 H_P: 59.6 H_A: 170.6	
LOI-2	80:10:45 14.4 sec 138.5 fps	R: 0.1 P: 182.4 Y: 357.6	R: 0.1 P: 221.0 Y: 357.6	Light (SR + 20:45)	X: -138.5 Y: 0.0 Z: 0.0	2 Jet 17 sec ΔV:	G&N Auto	LLS-2	WT: 68,821 H_P: 59.6 H_A: 60.2	
CSM Sep. Mnvr.	98:35:16 6.9 sec 2.5 fps	R: 0.0 P: 269.8 Y: 0.0	R: 0.0 P: 194.2 Y: 0.0	Light (SS - 14:44)	X: 0.0 Y: 0.0 Z: 2.5	None	G&N	LLS-2	WT: 36,484 H_P: 59.2 H_A: 60.1	
LM Jettison	108:09:24 5.6 sec 2.0 fps	R: 180.0 P: 89.9 Y: 0.0	R: 180.0 P: 70.3 Y: 0.0	Light (SS - 32:36)	X: 0.0 Y: 0.0 Z: -2.0	None	G&N	LLS-2	WT: 36,674 H_P: 59.3 H_A: 60.0	
TEI	137:20:22 2 min 50 sec 3622.5 fps	R: 179.9 P: 350.4 Y: 359.9	R: 180.0 P: 52.4 Y: 359.8	Light (SR + 13:22)	X: 3618.1 Y: -34.8 Z: 1176.4	2 Jet 14 sec ΔV:	G&N Auto	LLS-2	WT: 36,575	
MCC-5 thru MCC-7	152:20) 176:50) GETI 188:50)			Light	Nom. Zero		G&N Auto	PTC PTC Entry		TEI + 15 hours EI 15 hours EI 191:50 EI 3 hours

NOTE: H_A & H_P are distances above LLS-2 (not mean radius)

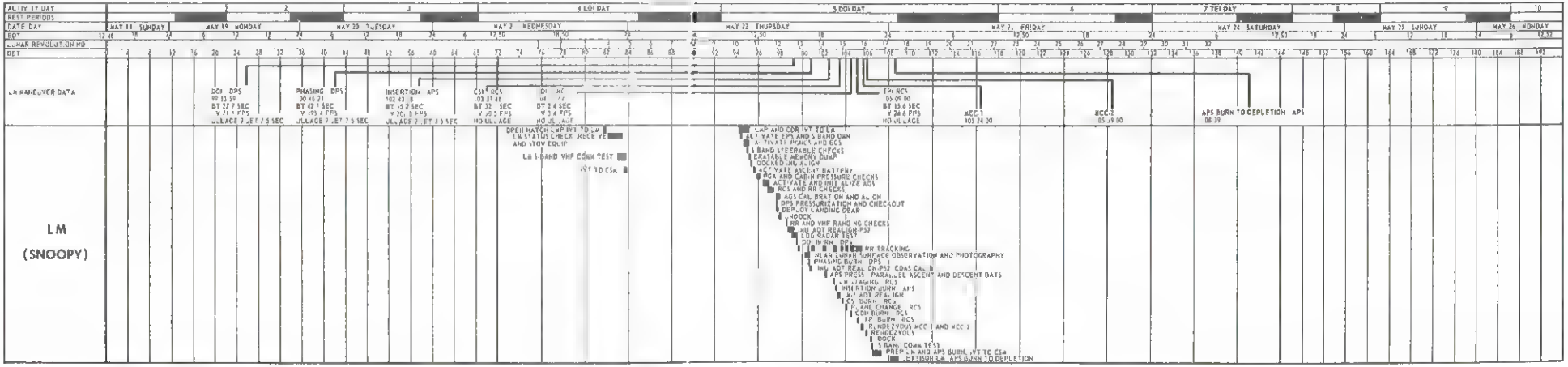
LM BURN SCHEDULE

Burn/Mnvr.	GETI Burn Time ΔV_c	Attitude (deg) LH/LV	Attitude (deg) Inertial	Lighting at GETI	ΔV (fps)	Ullage ΔV (fps)	TVC Mode	REFSMMAT	(SC wt., $Hp H_A$)	Remarks
DOI	99:33:59 27.7 sec 71.1 fps	R: 0.0 P: 180.0 Y: 0.0	R: 358.6 P: 286.4 Y: 4.8	Darkness (SR - 2 min)	X: -69.6 Y: 0.0 Z: 0.3	2 Jet 7.5 sec 1.5 fps	PGNCS Auto	LLS-2	WT: 37,758 H_A: 59.5 Hp: 8.8	DPS 10% thrust 15 sec 40% thrust to burn completion Retrograde face up
Phasing	100:46:21 42.1 sec 195.4 fps	R: 0.0 P: 25.9 Y: 0.0	R: 0.7 P: 261.4 Y: 4.9	Darkness (SS+5 min)	X: 169.1 Y: 0.0 Z: -94.8	2 Jet 7.5 sec 1.6 fps	PGNCS Auto	LLS-2	WT: 31,070 H_A: 195.1 Hp: 9.2	DPS 10% thrust 26 sec 92.5% thrust to burn completion Posigrade face down
Insertion	102:43:18 15.2 sec 207 fps	R: 180.0 P: 155.6 Y: 0.0	R: 177.7 P: 62.1 Y: 355.6	Daylight (SS - 5 min)	X: -189.2 Y: 0.1 Z: -83.8	2 Jet 3.5 sec	PGNCS Auto	LLS-2	WT: 8,412 H_A: 45.8 H_P: 8.6	LM staging 10 min before insertion burn Retrograde face down
CSI	103.33.46 32.1 sec 50.5 fps	R: 0.0 P: 0.0 Y: 0.0	R: 1.4 P: 106.1 Y: 355.2	Darkness (SR - 3 min)	X: 50.5 Y: 0.0 Z: 0.6	None	PGNCS Auto	LLS-2	WT: 8,241 H_A: 45.2 H_P: 45.0	Retrograde face up RCS + X thrust 4 Jet
CDH	104:31:44 2.3 sec 3.4 fps	R: 0.0 P: 90.0 Y: 0.0	R: 355.2 P: 16.1 Y: 358.6	Daylight (SS - 14 min)	X: -0.7 Y: 0.0 Z: 3.2	None	AGS Auto	LLS-2	WT: 8,195 H_A: 44.4 H_P: 44.2	RCS + Z thrust 2 Jet
TPI	105:09:00 15.6 sec 24.6 fps	R: 359.9 P: 26.0 Y: 0.2	R: 4.8 P: 189.5 Y: 1.1	Darkness (SR - 12 min)	X: 22.1 Y: 0.0 Z: -11.1	None	PGNCS Auto	LLS-2	WT: 8,192 H_A: 61.8 Hp: 43.8	RCS + X thrust 4 Jet Posigrade face down
Rndv. MCC-1	105:24:00	R: 0.2 P: 210.2 Y: 0.4	R: 2.2 P: 246.5 Y: 4.1	Darkness	TBD	None	TBD	LLS-2	WT: 8,169	Retrograde face up
Rndv. MCC-2	105:39:00	R: 0.2 P: 216.7 Y: 0.4	R: 2.2 P: 246.5 Y: 4.1	Darkness	TBD	None	TBD	LLS-2	WT: 8,158	Retrograde face up
APS Burn to Depl.	108:39	NOTE: H_A & Hp are distances above LLS-2 (not mean radius)					AGS Auto			Start burn in PGNCS auto & switch to AGS auto

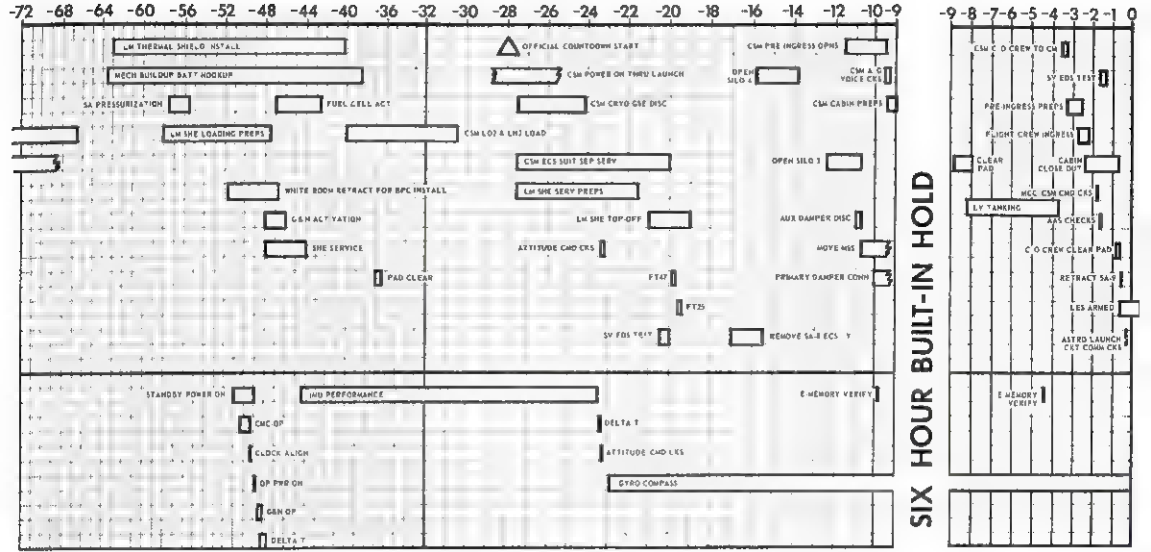
APOLLO 10
SUMMARY FLIGHT PLAN



APOLLO 10
SUMMARY FLIGHT PLAN



LAUNCH COUNTDOWN SC 106

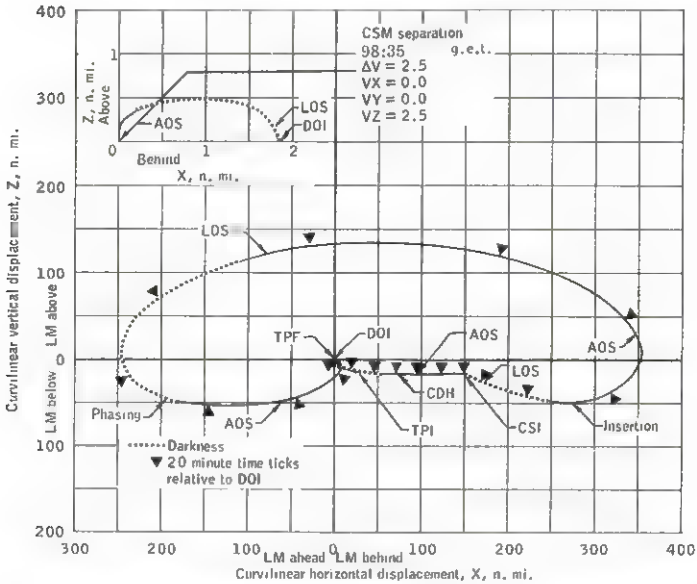


APOLLO 10 MISSION EVENTS (CSM)

G.E.T. Hr:Min:Sec:	EVENT
	LAUNCH 12:48 PM EDT 11:48 AM CDT
00:11 43	Earth Orbit Insertion
00:16	CMC Lift-Off Time Update
00:43	P52 REFS
01 40	P27 Update State Vector
02:33:26	S-IVB TLI BT 5m 2 2sec ΔV 10, 058 fps
03:00	CSM/S-IVB Separation TV Pass (3.00 3:15)
03:10	Docking
03:48	P30
04:09	LM Ejection
04:12	P40 SPS Thrust
04:26	CSM/LM SPS Evasive MNVR BT 2, 8 sec, ΔV 19.7 fps
05:00	P52 REFS
05 20	P27
05 30	P23 Cislunar Nav (5 sets)
10 00	P27
10:10	P30 Ext ΔV
10:40	P52 REFS
11.10	P40 SPS Thrust
11:33	MCC_1 BT 8, 1 sec ΔV 57 fps
11:50	P27
11 55	P52 REFS
12.00	Establish PTC Mode
24:45	P52 REFS
24:55	P23 Optics CAL
25:10	P23 Cislunar Nav (5 sets)
25:54	P27
26:03	P30 Ext ΔV
26:10	P40/P41 SPS, RCS Thrust
26.15	SXT/Star chk
26:33	MCC_2
27:15	TV Pass (27:15-27:30)
33:10	P27
44:35	P27
44.50	P52 REFS
52:15	P27
52:45	P52 REFS
53:20	P40/P41 SPS/RCS Thrust
53:45	MCC_3
54:00	TV Pass (54:00-54.15)
69 25	P27
69:40	P52 PREF
70:00	P30 Ext ΔV
70 25	P40/P41 SPS/RCS Thrust
70:45	MCC_4
72:20	TV Pass (72:20-72:35)
74:00	P52 REFS
74:10	P27
74:15	P30 Ext ΔV
75:20	P40 SPS Thrust
75:45	LOI_1 BT 6m 2 sec ΔV 2974 fps, 60 X 170 orbit
77:00	P52 REFS
78:32	P27
78:55	P30
79:03	P52 REFS
79:30	SXT Star chk
79:50	P40 SPS Thrust
80:10	LOI_2 BT 14. 4 sec ΔV 138 fps, 60 X 60 orbit
80:45	TV Pass (80:45-80:55)
81:10	P52 REFS
81.50	LMP IVT to LM
82:20	P22 (Orbit NAV)
83:10	P27
83:42	LMP IVT to CSM
84:35	P27
94.20	P27
94.27	LMP IVT to LM
94:50	P52 PREF
94:52	CDR IVT to LM
95:12	LMP IVT to CSM
95:23	LGC/CMC Clock Set & Tephem Update
95:37	LMP IVT to LM
96,25	P22 Orbital Nav
97:03	P27
98.10	Undock
98:13	TV Pass (98:13-98:23)
98:34	P30, P41
98 35	CSM SEP
98:42	P20
99:05	P27
100:28	P20 Auto MNVR to SXT Track
100:43	P76 TGT ΔV
102:15	P27
102:30	P30
102:46	CSM Insertion
102:50	P52 REFS
102:53	P27, CSM & LM State Vector
103:10	SXT/VHF Tracking
103,27	P40 Auto MNVR
103:40	P76, P20
103.50	SXT/VHF Tracking
104:07	P76
104:26	P33

G.E.T. Hr:Min:Sec	EVENT
104:29	P41
104:50	SXT/VHF Track
105:03	P40
105:12	P76, P35, P20
105:27	P76 TGT Load
105:54	Rendezvous
106:00	Formation Flying
106:20	Docking
106:45	MNVR to APS Depletion Attitude
108:09	LM Jettison and CSM Final Sep MNVR ΔV: 2 fps up
108:35	TV Pass (108:35-108:50)
108:55	P27
118:40	P27
119:00	P52 REFS
120:43	P27
122:23	P22 Orbital Nav
122:35	P52 REFS
122:37	P27 Update
122:40	P52 REFS
123:22	P22 Orbital Nav
124:32	P27 Update
124:37	P52 REFS
125:15	P22 Orbital Nav
126:33	P27 Update
126:37	P52 REFS
127:15	P22
128:27	P27
132:27	P27 Update
132:33	P52 REFS
134:00	P22
134:32	P27 Update
135:45	P27 Update
135:48	P30 Ext ΔV & DAP Load chk
136:27	P52 REFS
136:40	P30 P40 SPS Thrust
137:05	SXT Star chk
137:20	TLI BT 2m50sec ΔV 3622.5 fps
137:45	TV Pass (137:45-138:00)
137:57	P27 Update
138:20	P22 PREF
140:04	P27
147:32	P27
150:30	P52 REFS
150:35	P23 Optics CAL
150:45	P23 Mid Course Nav
151:30	P27
151:40	P30 Ext ΔV
152:00	P40/P41 SPS/RCS Thrust
152:20	MCC_5
152:35	TV Pass (152:35-152:45)
164:45	P27
164:55	P52 REFS
165:05	P23 Optics CAL
165:10	P23 Mid Course Nav
167:20	P23 Optics CAL
167:28	P23 Mid Course Nav
171:05	P23 Optics CAL
171:10	P23 Mid Course Nav
174:20	P23 Optics CAL
174:28	P23 Mid Course Nav
175:08	P27
175:20	P30 Ext ΔV
175:30	P52 REFS
176:30	P40/P41 SPS/RCS Thrust
176:50	MCC_6
186:50	TV Pass (186:50-187:05)
187:20	P27
187:33	P52 PREF
188:03	P30 Ext ΔV
188:30	P40 P41 SPS RCS Thrust
188:50	MCC_7
189:50	Boresight & SXT Star chk
190:10	P52 REFS
190:45	P27
191:35	CM SM Separation
191:50	EI 400K
191:57	Guidance Termination
191:58	Drouge Deployment
191:59	Main Deployment
192:04	SPLASHDOWN

CURVILINEAR DISPLACEMENT



Relative Motion (curvilinear, CSM-centered) for LM Active Phase of F Mission

APOLLO 10 MISSION EVENTS (LM)

G.E.T.	EVENT
81:50	LMP IVT to LM
	Receive Equip. from CSM and Perform General Housekeeping
83:42	LMP IVT to CSM
94:27	LMP IVT to LM
94:52	CDR IVT to LM
94:53	PGNCS Turn-on & Self Test
95:12	LMP IVT to CSM
95:23	LGC/CMC Clock Set & Tephem Update
95:40	Docked Manual IMU Align
96:53	P27, Update
97:00	PIPA Bias chk
98:10	Undock
98:23	P27
98:35	CSM Sep
98:38	P27
98:40	P30 Ext ΔV
98:57	P52 REFS
99:28	P40 DPS Thrust
99:34	DOI, DPS Burn BT:27.7 sec ΔV:71.1 fps, 7.5 sec Ullage
99:37	Initiate RR Tracking
99:43	Terminate RR Tracking
100:30	Landing Site Approach Path Monitoring
100:42	P40 Ext ΔV
100:46	Phasing, DPS Burn BT:42 sec ΔV 195.4 fps, 7.5 sec Ullage
100:50	RR ON, P20
100:56	RR OFF
101.05	P52 REFS, COAS CALIB
101:15	RR ON, Initiate RR Tracking
101:25	RR OFF
102:08	RR ON, Initiate Tracking
102:20	RR OFF, P47, ΔV Monitor
102:33	RCS Staging ± X=2 fps
102:37	P30, P42
102:43	Insertion, APS BT: 15.2/sec ΔV 202.0 fps, 3.5 sec Ullage
102.55	P52 REFS
103:00	RR ON, Initiate Tracking
103:25	P41, RCS Thrust
103.33	CSI, RCS BT:32.1 sec ΔV 50.5 fps
103:37	P33 CDH Pre-Thrust
103:57	P41 RCS Thrust
104:01	RCS Plane Change ΔV=0
104:03	P20 Initiate RR Tracking
104:27	P41 RCS Thrust
104:31	CDH, RCS BT:2.4 sec ΔV 3.4 fps
105:02	P41 RCS Thrust
105:09	RCS TPI BT: 15.6 sec ΔV 24.6 fps
105:20	P41 RCS Thrust
105:24	MCC_1
105:37	P41 RCS Thrust
105:39	MCC_2
105:50	Braking MNVRS
105:54	Rendezvous
106:00	Formation Flying
106:20	Docking
106:25	P27
106:33	PIPA Bias chk
107:10	CDR IVT to CSM
107:25	LMP IVT to CSM
107:35	Unstow & Install Fwd Hatch
108:09	LM Jettison
108:39	APS Burn to Depletion

RENDEZVOUS PROFILE (TYPICAL)

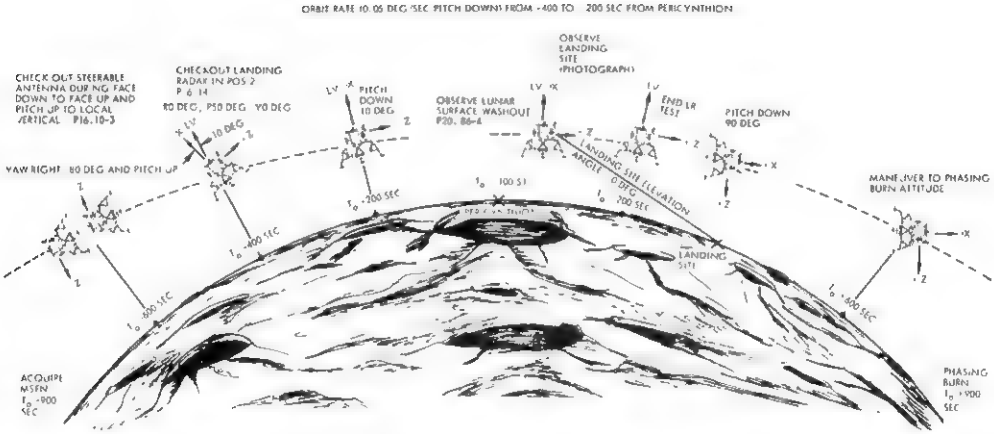
'P' MISSION RENDEZVOUS TRAJECTORY
(CSM CENTERED CURVILINEAR COORD

EVENT NO	EVENT	GET
1	CSM SEPARATION	89 33 16
2	DOI	89 33 39
3	PHASING BURN	00 46 23
4	INSERTION BURN	02 43 58
5	CSI	03 28 06
6	CDH	24 3 42
7	TPI	03 09 00
8	NCC	91 34 00
9	NCC 2	103 29 00
10	RENDEZVOUS	105 54 00

LEGEND

——— NIGHT

– – – – DAYLIGHT



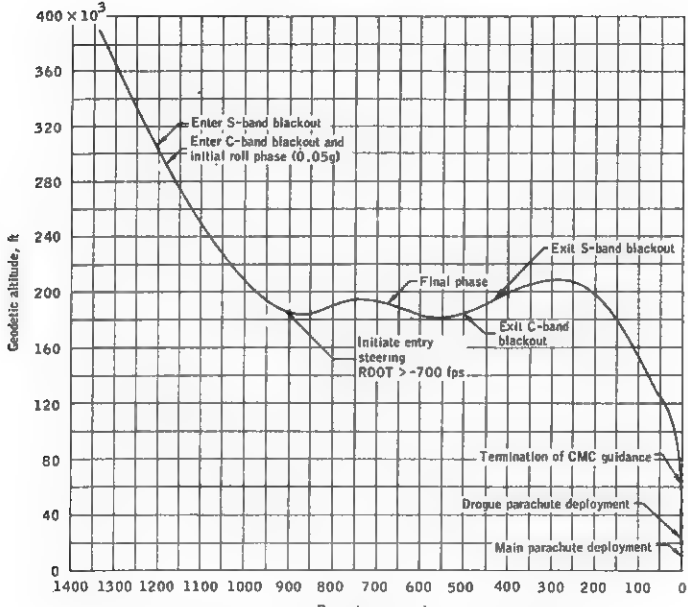
NEAR LUNAR SURFACE ACTIVITY

191 50 E.I.

ENTRY INTERFACE

Event	Time from E.I.	
	Min	Sec
400,00 ft.	00	00
Enter S Band Blackout	00	26
0.05 G	00	30
KA Initiate Constant Reag	00	52
RDOT = -700 FPS	01	21
Peak G	01	24
P64 to P67	02	10
Exit S Band Blackout	03	26
Guidance Termination	07	30
Drogue Deployment	08	33
Main Deployment	09	22
Touchdown	14	15

APOLLO 10 ENTRY PROFILE



GEODETIC ALTITUDE VERSUS RANGE TO GO

CHECKLIST REF CODES (V50N25)

R1 CODE	ACTION
00013	PERFORM COARSE ALIGN
00014	PERFORM FINE ALIGN
00015	ACQUIRE CELESTIAL BODY
00016	TERMINATE MARKS
00041	CM/SM SEP
00062	KEY CMC TO STBY
00202	G&N AUTO MNVR
00204	SPS GMBL TRIM

ALARM CODES (V05N09)

CODE	DESCRIPTION	CORRECTIVE ACTION
00110	MARK REJECT UNNECESSARY	RSET/CONT
00112	MARK NOT ACCEPTED	RSET/CONT
00113	NO INBITS	RSET/REATTEMPT ENTRY
00114	MARK NOT DESIRED	RSET/CONT
00115	TOR REQ - OSS NOT IN CMC	SET OSS TO CMC/RSET/CONT
00116	OSS SW BEFORE IS SEC	SET OSS TO ZERO/RSET/CONT
00117	TOR REQ - OSS NOT AVAIL	RSET
00120	TOR REQ - OSS NOT ZEROED	SET OSS TO ZERO/RSET/CONT
00121	CDUS NO GO AT MARK	RSET/REPEAT MARK
00122	MARKING NOT CALLED FOR	RSET/CONT
00124	NO SOLUTION TO TPI	RSET/V32E
00205	PIPA SATURATED	RSET/SWITCH TO SCS
00206	ZERO ENCODE NOT ALLOWED	RSET/V41/V40
00211	COARSE ALIGN ERROR	RSET/REPEAT AND/OR FA CK
00217	ISS MODE SWITCH FAIL	RSET/REINITIATE PROG. CONT
00220	IMU NOT ALIGNED	RSET/P51 OR SET FLAG
00401	DESIRED ANGLES GMBL LOCK	RSET/AVOID GMBL LOCK
00404 #	TARGET OUT OF 90 DEG	RSET/MNVR NEW TGT
00405	TWO STARS NOT AVAIL	MNVR/RSET/V32E/NEW STAR
00406	P20 NOT OPERATING	RSET
00407	TARGET OUT OF 50 DEG	RSET/MNVR
00421	W MATRIX OVERFLOW	RSET/NOTIFY MSFN CONT
00430	ACC OVERFLOW IN INTEG	RSET/REINITIATE PROG
00600	IMAG ROOTS FIRST ITER	RSET/V32E ADJUST INPUT PARAMETERS
00601	HP POST CSI LOW	
00602	HP POST CDH LOW	
00603	TIG CSI-CDH < 10 MIN	
00604	TIG CDH-TPI < 10 MIN	
00605	ITER > LOOP MAX	
00606	ΔV EXCEEDS MAX	
00607	NO SOL TIME θ OR R	RSET/REINITIATE PROG
00611	NO TIG FOR ELEV ANGLE	PRO NEW ELEV/RSET
01105	DOWN TEL TOO FAST	RSET
01106	UP TEL TOO FAST	RSET/RETRANSMIT
01207 *	NO VAC AREA FOR MARKS	RSET/TERM, REINITIATE P51/P52
01211 *	ILLEGAL RUPT OF EXTD VERB	RSET/TERM RE NITIATE PROG
01302	NO SOLUTION	RSET/N08, NOTIFY MSFN, CONT
01407	VG INCREASING	TERMINATE THRUST/RSET
01426	IMU UNSAT	RSET/REALIGN IMU
01427	IMU REVERSED	RSET/CONT/0 DEG = LIFT DN
01520	V37 NOT ALLOWED	RSET/RESELECT V37
01521 *	POI ILLEG SELECT	RSET/REINITIATE PROG
01703	CANNOT INTEG SV TO TIG	RSET/AUTO TIG SLIP

* RESTART # AUTO DISPLAY

VERB LIST
40 ZERO ICDU
41 COARSE
42 FINE
43 LOAD ERRORS
46 ACTIVATE DAP
47 LM INTO CSM
48 LOAD DAP
49 CREW MNVR
54 COAS MARK
55 ADD ΔTIME
56 STOP TRACK
57 SXT MARK
58 RESET STICK
60 SET NI7=N20
61 FOLLOW ERR
62 FINAL ERR
63 NI7 ERR
64 S BD ANT
66 CSM TO LM
67 W MATRIX RMS
68 STROKER
70 UPDATE LO
71 BLOCK UPDATE
72 SINGLE UPDATE
73 UPDATE TIME
74 ERASE DUMP
76 SET PREF FLG
77 RESET PREF
80 UPDATE LM SV
81 UPDATE CSM SV
82 ORBIT PARAM
83 R, R DOT, THETA
85 R, R DOT, PHI
86 REJ COAS MK
89 RNDZ AT T MNVR
90 OUT OF PLANE
93 INITIALIZE W
96 TERM INTEG
NOUN LIST
17 CRW.AT
20 PRE.AT
22 NEW AT
24 ΔTIME
32 T FM PER
33 TIG
35 T FM EVT
37 TIG TPI
38 T ST VEC
39 ΔT TNFR
40 TF TIG
VGXX.X
ΔV MX.X
41 TGT.AZ
TG TEL
IDENT
42 HAXX.X
HPXX.X
ΔV RE.Q
43 LAT XX
LON.GX
ALTX.X
44 HAXX X
HPXX X
TFF
49 ΔRXX X
ΔVXX X
S CODE
50 ΔR MI S
HPXX.X
TFF
51 RHO.XX
GAM MA
53 RAN GE
RDOT X
PHI.XX
54 RANGE
RDOT.X
THE TA
55 P CODE
ELE.VX
CEN.AN
56 ENA.NG
ΔVXXX.
57 ΔR SO R
58 HPXX.X
ΔV TP I
ΔV TP.F
59 ΔV LO.S
61 LAT.XX
LON.GX
72 ΔAN.GX
ΔALT.X
73 ALTXX.
VELXX.
GAM MA
80 TF TIG
VGXXX
ΔVMXX
81 ΔV LV X
84 ΔV LM X
85 ΔV CO N
87 TR.UNN
88. PLANT
89 LA TXX
LN.G/2
ALT XX
90 YXX.XX
YDOT X
PSI XX
91 PRS.FT
PR TRN
92 NWS FT
NW TRN
93 ΔG.YRO
94 SHA.FT
TR UNN
95 PRF.AT
96 +XA.TT
99 POS ER
VELE.R
W CODE

NOUN 70 CODES

R1: CELESTIAL BODY CODE 000XX

00 PLANET
01 ALPHERATZ
02 DIPHDA
03 NAVI
04 ACHERNAR
05 POLARIS
06 ACAMAR
07 MENKAR
10 MIRFAK
11 ALDEBARAN
12 RIGEL
13 CAPELLA
14 CANOPUS
15 SIRIUS
16 PROCYON
17 REGOR
20 DNOCES
21 ALPHARD
22 REGULUS
23 DENEBOLA
24 GIENAH
25 ACRUX
26 SPICA
27 ALKAID
30 MENKENT
31 ARCTURUS
32 ALPHECCA
33 ANTARES
34 ATRIA
35 RASALHAGUE
36 VEGA
37 NUNKI
40 ALTAIR
41 DABIH
42 PEACOCK
43 DENEB
44 ENIF
45 FOMALHAUT
46 SUN
47 EARTH
50 MOON

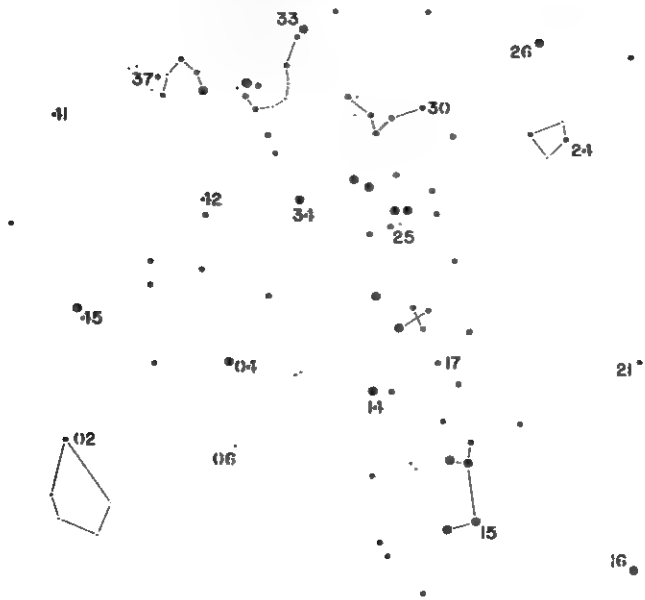
R2: LANDMARK DATA ABCDE

A = 1 IF KNOWN LDMK
A = 2 IF UNKNOWN LDMK
B = INDEX OF OFFSET DESIG
C = NOT USED
DE = LDMK ID NO

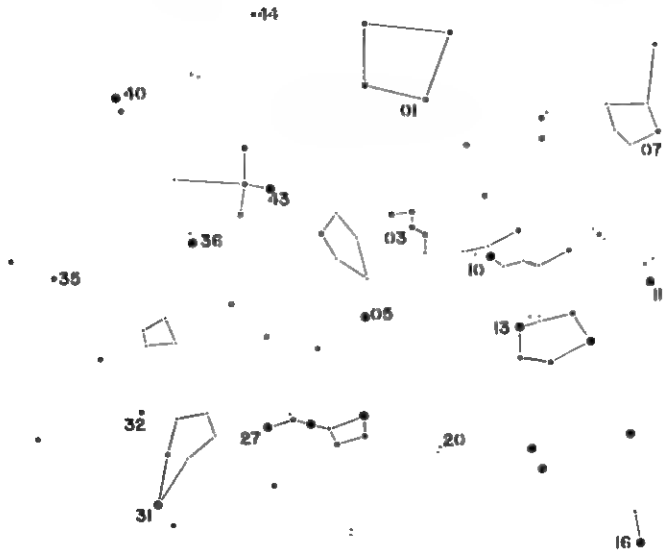
R3: HORIZON DATA 00CD0

C = 1 FOR EARTH HORIZON
C = 2 FOR MOON HORIZON
D = 1 FOR NEAR HORIZON
D = 2 FOR FAR HORIZON

SOUTH STAR CHART



NORTH STAR CHART



COMPUTER PROGRAMS

PHASE	PROGRAM NUMBER	PROGRAM TITLE
PRE-LAUNCH	00	CMC IDLING
AND	01	PRELAUNCH OR SERVICE-INITIALIZATION
SERVICE	02	PRELAUNCH OR SERVICE-GYRO COMPASSING
	03	PRELAUNCH OR SERVICE-OPTICAL VERIFICATION OF GYRO COMPASSING
	06	GNCS POWER DOWN
	07	SYSTEMS TEST
BOOST	11	EARTH ORBIT INSERTION MONITOR (EOI)
	17	TRANSFER PHASE INITIALIZATION SEARCH (TPI)
COAST	20	RENDEZVOUS NAVIGATION
	21	GROUND TRACK DETERMINATION
	22	ORBITAL NAVIGATION
	23	CISLUNAR MIDCOURSE NAVIGATION
	27	CMC UPDATE
PRE-	30	EXTERNAL DELTA V
THRUSTING	31	LAMBERT AIMPOINT MANEUVER
	32	CO-ELLIPTIC SEQUENCE INITIATION (CSI)
	33	CONSTANT DELTA ALTITUDE (CDH)
	34	TRANSFER PHASE INITIATION (TPI)
	35	TRANSFER PHASE (MIDCOURSE)
	37	RETURN TO EARTH (RTE)
	38	STABLE ORBIT RENDEZVOUS (SOR)
	39	STABLE ORBIT MIDCOURSE (SOM)
THRUSTING	40	SPS
	41	RCS
	47	THRUST MONITOR
ALIGNMENT	51	IMU ORIENTATION DETERMINATION
	52	IMU REALIGN
	53	BACK-UP IMU ORIENTATION DETERMINATION
	54	BACK-UP IMU REALIGN
ENTRY	61	ENTRY-MANEUVER TO CM/SM SEPARATION ATTITUDE
	62	ENTRY-CM/SM SEPARATION AND PRE-ENTRY MANEUVER
	63	ENTRY INITIALIZATION
	64	ENTRY-POST 0.05G
	65	ENTRY-UP CONTROL
	66	ENTRY-BALLISTIC
ABORT	67	ENTRY-FINAL PHASE
	72	LM CO-ELLIPTIC SEQUENCE INITIATION (CSI) TARGETING
	73	LM CONSTANT DELTA ALTITUDE (CDH) TARGETING
	74	LM TRANSFER PHASE INITIATION (TPI) TARGETING
	75	LM TRANSFER PHASE (MIDCOURSE) TARGETING
	76	LM TARGET DELTA V
	77	LM TPI SEARCH
	78	LM SOR TARGETING
	79	LM SOM TARGETING

LGC PROGRAMS

NUMBER	TITLE
SERVICE	
P00	LGC IDLING
P06	PGNCS POWER
P07	SYSTEMS TEST (NON-FLIGHT)
ASCENT	
P12	POWERED ASCENT GUIDANCE
COAST	
P20	RENDEZVOUS NAVIGATION
P21	GROUND TRACK DETERMINATION
P22	RR LUNAR SURFACE NAVIGATION
P25	PREFERRED TRACKING ATTITUDE
PRETHRUSTING	
P30	EXTERNAL DELTA V
P31	LAMBERT AIMPOINT GUIDANCE
P32	CO-ELLIPTIC SEQUENCE INITIATION (CSI)
P33	CONSTANT DELTA ALTITUDE (CDH)
P34	TRANSFER PHASE INITIATION (TPI)
P35	TRANSFER PHASE MIDCOURSE (TPM)
P38	STABLE ORBIT RENDEZVOUS (SOR)
P39	STABLE ORBIT MIDCOURSE (SOM)
THRUST	
P40	DPS THRUSTING
P41	RCS THRUSTING
P42	APS THRUSTING
P47	THRUST MONITOR
ALIGNMENTS	
P51	IMU ORIENTATION DETERMINATION
P52	IMU REALIGN
P57	LUNAR SURFACE ALIGNMENT
DESCENT & LANDING	
P63	LANDING MANEUVER BRAKING PHASE
P64	LANDING MANEUVER: APPROACH PHASE
P65	LANDING PHASE (AUTO)
P66	RATE OF DESCENT LANDING (ROD)
P67	LANDING PHASE (MANUAL)
P68	LANDING CONFIRMATION
ABORTS AND BACKUPS	
P70	DPS ABORT
P71	APS ABORT
P72	CSM CO-ELLIPTIC SEQUENCE INITIATION (CSI) TARGETING
P73	CSM CONSTANT DELTA ALTITUDE (CDH) TARGETING
P74	CSM TRANSFER PHASE INITIATION (TPI) TARGETING
P75	CSM TRANSFER PHASE MIDCOURSE (TPM) TARGETING
P76	TARGET DELTA V
P78	CSM STABLE ORBIT RENDEZVOUS (SOR) TARGETING
P79	CSM STABLE ORBIT MIDCOURSE (SOM) TARGETING

ABBREVIATIONS

ACN	Ascension Tracking Station
AGS	Abort Guidance System
ANG	Antigua Tracking Station
APS	Ascent Propulsion System
BDA	Bermuda Tracking Station
BT	Burn Time
CAL	California Tracking Station
CDH	Constant Differential Height
CES	Control Electronics System
CRO	Carnarvon Tracking Station
CSI	Concentric Sequence Initiation
CSM	Command and Service Modules
CYI	Grand Canary Island
DAP	Digital Autopilot
DOI	Descent Orbit Insertion
DPS	Descent Propulsion System
EMU	Extravehicular Mobility Unit
EPO	Earth Parking Orbit
EVA	Extravehicular Activity
EVT	Extravehicular Transfer
FTP	Fixed Throttle Point
GBM	Grand Bahama Tracking Station
GDS	Goldstone Tracking Station
g.e.t.	ground elapsed time
G.m.t.	Greenwich mean time
G&N	Guidance and Navigation
GYM	Guaymas Tracking Station
HAW	Hawaii Tracking Station
IVC	Invervehicle Communications
IVT	Intravehicular Transfer
LM	Lunar Module

ABBREVIATIONS

LOI	Lunar Orbit Insertion
LOS	Loss of Signal
LPO	Lunar Parking Orbit
LR	Landing Radar
MER	Mercury Tracking Ship
MIL	Merritt Island Tracking Station
MSFN	Manned Space Flight Network
PGA	Pressure Garment Assembly
PGNCS	Primary Guidance and Navigation Control Subsystem
PLSS	Portable Life Support System
PRE	Pretoria Tracking Station
RCS	Reaction Control Subsystem
RR	Rendezvous Radar
SECO	SIVB Engine Cut-off
SLA	Spacecraft LM Adapter
SPS	Service Propulsion System
S-IC	Saturn IC, LV First Stage
S-II	Saturn II, LV Second Stage
S-IVB	Saturn IVB, LV Third Stage
TAN	Tananarive Tracking Station
TEC	Transearth Coast
T&D	Transposition and Docking
TEI	Transearth Insertion
TEX	Corpus Christi Tracking Station
TLC	Translunar Coast
TLI	Translunar Injection
TPF	Terminal Phase Finalization
TPI	Terminal Phase Initialization
TPM	Terminal Phase Midcourse
TVC	Thrust Vector Control
VAN	Vanguard Tracking Ship
ΔV	Velocity Change (Differential)
ΔVC	Velocity Change at Engine Cut-off
ΔR	Position Change (Differential)

NEWS CENTERS

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NASA-Kennedy Space Center 867-2468
NASA-Recorded Information 867-2525
Joint Industry Press Center ..... Gold Room Ramada Inn

HOUSTON

NASA-Manned Spacecraft Center 483-5111
NASA-Recorded Information 483-4479
Joint Industry Press Center ..... Sheraton King's Inn 488-5472

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Milwaukee, Wisconsin 53201 Nightline 762-1748

FOR APOLLO 10 MISSION:

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Dave Hudgens (Houston) ..... Sheraton King's Inn 488-0220
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Eastern	773-1270	224-6211
Delta	636-3144	225-2311
Braniff		621-3111
American		222-9873
Continental		524-4711

GROUND

Avis	783-3643	643-0673
Hertz	783-7771	224-5611
National	783-7007	649-5555
Limousine	783-7800	488-1539
Taxi	783-7200	483-4001

MOTELS

Cape Kennedy Hilton	783-0361	Holiday Inn	488-1518
Holiday Inn	783-2271	Nassau Bay Motor Inn	488-3402
Howard Johnson	883-9481	Ramada Inn	488-2216
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Sheraton Cape Colony	783-2252		
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